UCD LIBRARY

PHYSICAL SCIENCES LIBRARY

STATE OF CALIFORNIA

The Resources Agency

Department of Water Resources

BULLETIN No. 16-69

WEATHER MODIFICATION OPERATIONS IN CALIFORNIA

October 1, 1968 — September 30, 1969

LIBRARY

JUNE 1970

NORMAN B. LIVERMORE, JR.
Secretary for Resources
The Resources Agency

RONALD REAGAN
Governor
State of California

WILLIAM R. GIANELLI
Director
Department of Water Resources

ABSTRACT

Within the reporting period, October 1, 1968, through September 30, 1969, nine licensees conducted eleven weather modification projects in California. During this period, all projects except the two fog dispersal projects dispersed some form of silver iodide to increase precipitation. The fog dispersal projects, conducted at the Sacramento Metropolitan and the Los Angeles International airports, used finely ground sodium chloride to increase runway visibility on foggy days. Heavy rains in January and February shut down many projects early.

State of California
The Resources Agency
DEPARTMENT OF WATER RESOURCES

RONALD REAGAN, Governor, State of California
WILLIAM R. GIANELLI, Director, Department of Water Resources
JOHN R. TEERINK, Deputy Director

DIVISION OF RESOURCES DEVELOPMENT

Herbert W. Greydanus . . . . . Division Engineer

Lee W. Carter . . . . . Chief, Federal-Local Projects

This report was prepared by

Edward C. Greiner . . . . . Chief, Water Rights Engineering Section

and

Joseph B. Powers . . . . . Meteorologist III

CONTENTS

Weather Modification Operations 5

Project 1-69-1: Upper San Joaquin River Basin 5

Project 1-69-2: Upper Santa Ynez Valley 5

Project 12-69-1: Upper Kern River Basin 6

Project 18-69-1: San Gabriel Mountains 6

Project 21-69-1: Upper Kings River Basin 10

Project 23-69-1: Lake Almanor 10

Project 26-69-1: Santa Clara County 11

Project 30-69-1: Central Sierra Research 11

Project 31-69-1: Upper American River 12

Project 33-69-1: Fog Dispersal, Sacramento Metropolitan Airport . . 12

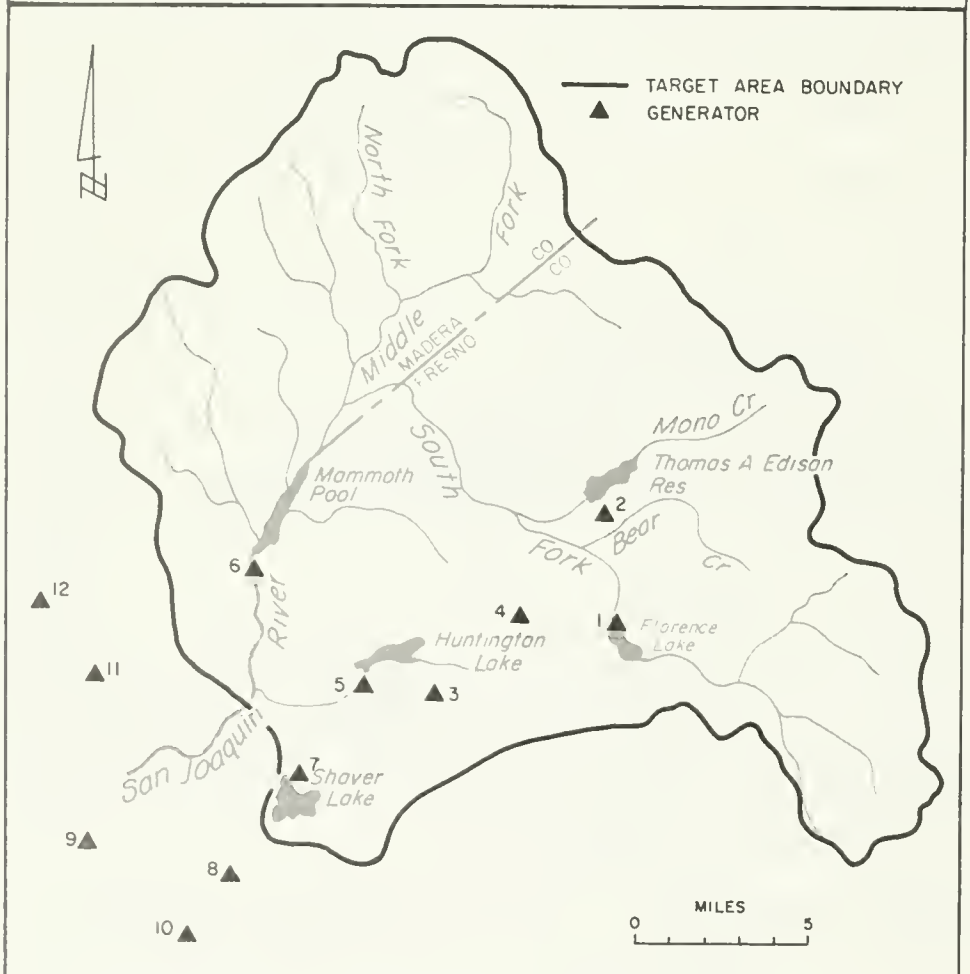
Project 33-69-2: Fog Dispersal, Los Angeles International Airport . 12

Plates

1 Weather Modification Projects in California: 1969 Water Year . . 8-9

2 Precipitation: October 1, 1968, to September 30, 1969 14

Summary	Month					Total
	Oct.	Nov.	Dec.	Jan.	Feb.	
Hours of Operation						
Generator No. / Location						
1 Florence	13.50	24.75	73.25	69.00	24.00	204.50
2 Vermilion	13.50	28.00	76.50	45.25	24.00	187.25
3 China Peak	31.50	57.00	106.75	44.00	36.50	275.75
4 Mt. Given	39.00	62.00	144.00	74.00	36.50	355.50
5 Huntington	36.25	62.00	133.75	74.00	36.50	342.50
6 Mammoth	38.50	61.75	147.25	65.75	0	313.25
7 Shaver	36.25	52.50	88.75	66.00	36.50	280.00
8 Pine Ridge	12.00	13.75	0	65.75	39.00	130.50
9 Auberry	12.00	13.75	97.50	66.50	40.25	230.00
10 Toll House	12.00	13.75	77.25	65.75	39.75	208.50
11 South Fork	11.75	13.75	99.25	19.50	0	144.25
12 Bass Lake	0	13.75	116.00	30.75	0	160.50
Total	256.25	416.75	1,160.25	686.25	313.00	2,832.50
Storms	3	6	4	4	1	18
Days of Seeding	4	8	13	7	3	35
AgI Used (grams)	1,537.5	2,500.5	6,961.5	4,117.5	1,878.0	16,995.0



PROJECT Nº I-69-I: UPPER SAN JOAQUIN RIVER BASIN

WEATHER MODIFICATION OPERATIONS

Within the reporting period, October 1, 1968, through September 30, 1969, nine licensees conducted eleven weather modification projects in California. During this period, all projects except fog dispersal projects (Projects 33-69-1 and 33-69-2) dispersed some form of silver iodide (AgI) as the only nucleating agent. The fog dispersal projects used finely ground sodium chloride (NaCl) as the nucleating agent. Plate 1 summarizes the projects. Days of cloud seeding reported are the days on which seeding operations took place. Seeding did not necessarily occur during all hours of the day.

Because of heavy rains in January and February, many of the projects shut down ahead of schedule.

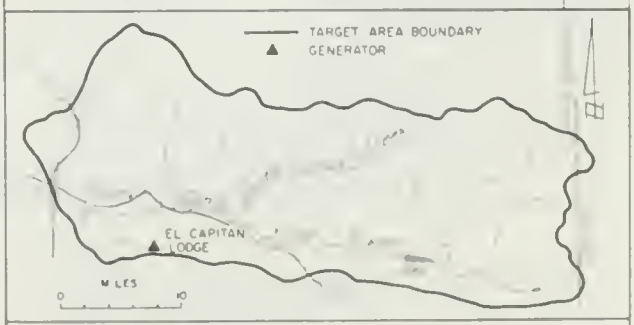
Neither the Sierra Cumulus Project of the Fresno State College Foundation nor the Southern Sierra Research Program of the Naval Weapons Center in China Lake operated during this reporting period. Each of these cumulus research projects had achieved its goal during the previous reporting period.

During this reporting period, the San Bernardino Valley Municipal Water District suspended operations (begun in 1960) of its Upper Santa Ana River Watershed Project so as to reorient the project to testing. The project will operate again in 1969-70.

Project No. 1-69-1: The Southern California Edison Company hired North American Weather Consultants to increase the snowpack in the upper San Joaquin River Basin above its Powerhouse No. 8. Twelve ground-based generators dispersed six grams of silver iodide per hour of operation.

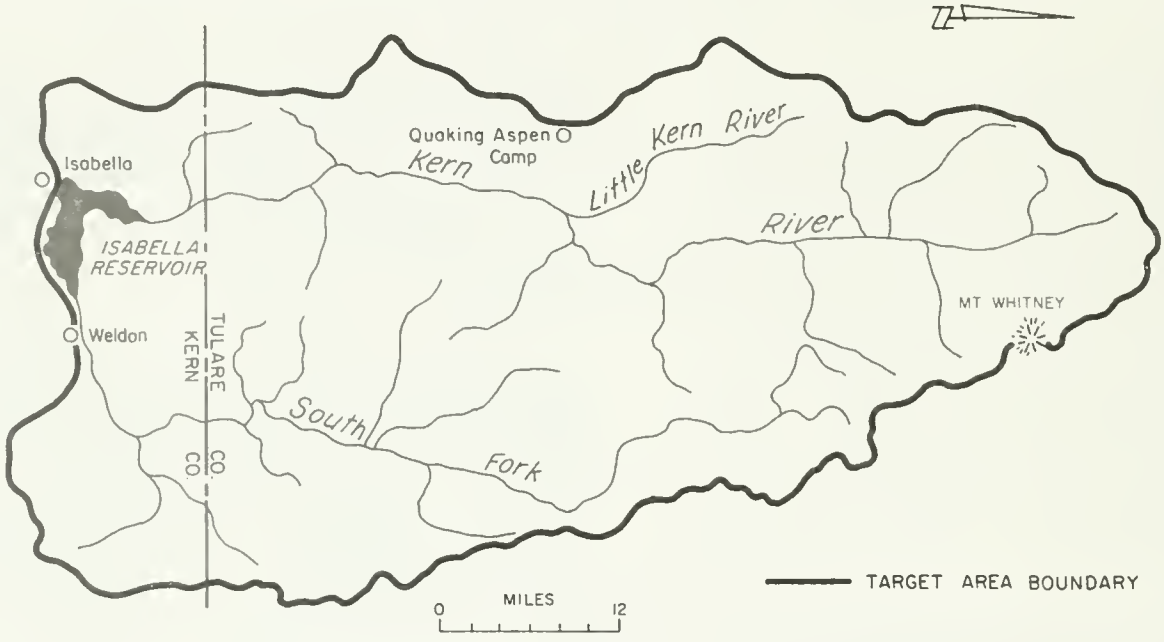
Project No. 1-69-2: The Naval Weapons Center in China Lake hired North American Weather Consultants to test ground-based pyrotechnic devices set at El Capitan Lodge for cloud seeding in the San Rafael Mountains and the Santa Ynez Valley above Solvang. Each of 129 LW-83 fusees dispersed 400 grams of silver iodide during its 3.2-minute burn.

Summary	Month						Total
	Nov	Dec	Jan	Feb	Mar	April	
Hours of Operation	0.50	3.50	13.00	8.25	-	2.75	28.00
Storms	1	2	6	5	-	1	15
Days of Seeding	1	2	4	5	0	1	13
Fusees Used	3	16	60	38	0	12	129
AgI Used (grams)	1,200	6,400	24,000	15,200	0	4,800	51,600



PROJECT Nº 1-69-2 UPPER SANTA YNEZ VALLEY

Summary	Month				Total
	Nov.	Dec.	Jan.	Feb.	
Hours of Flight Time	5.7	25.5	22.7	8.0	61.9
Storms	3	8	7	2	20
Flights	5	10	10	3	28
AgI Used (grams)	242	1,084	965	340	2,631

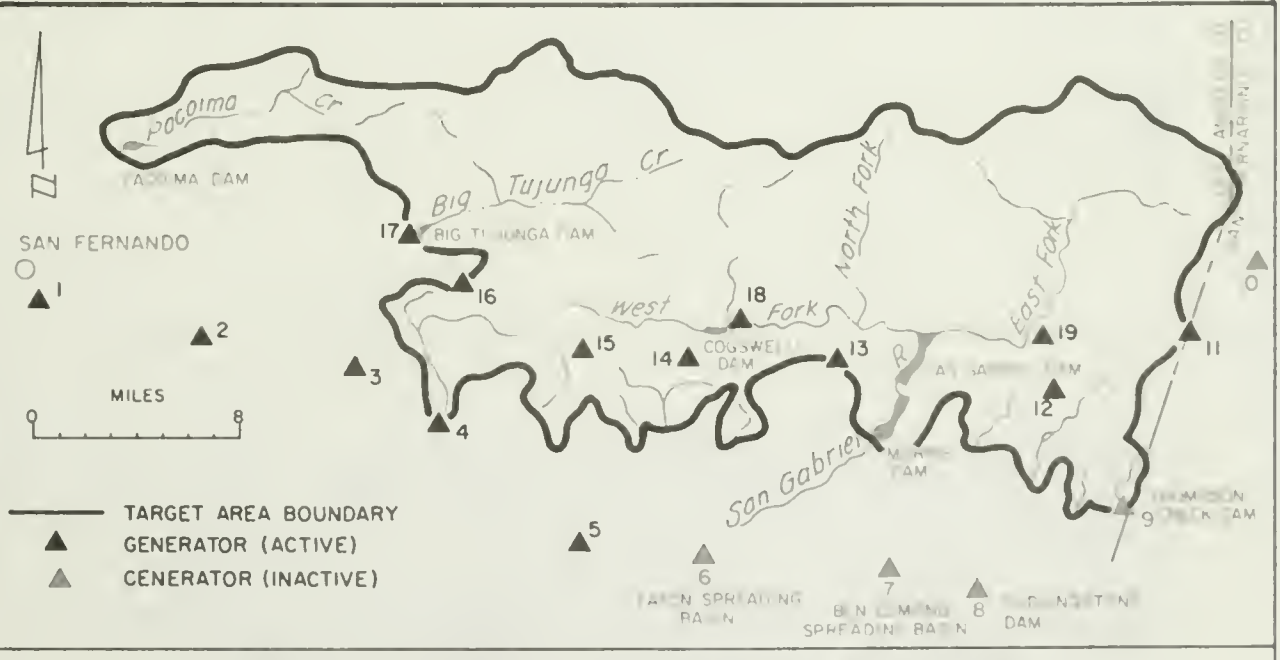


PROJECT Nº 12-69-1: UPPER KERN RIVER BASIN

Project No. 12-69-1: The Kern County Board of Supervisors hired Precipitation Control Company of California to increase precipitation and stream flow in the upper Kern River Basin. Aircraft, during 28 flights, dispersed silver iodide in smoke at the rate of $1\frac{1}{2}$ ounces (42.5 grams) per hour.

Project No. 18-69-1: The Los Angeles County Flood Control District sought to increase precipitation along the southerly slopes of the San Gabriel Mountains above its many dams on the San Gabriel River, Big Tujunga Creek and Pacoima Creek. Fourteen ground-based generators dispersed a two percent solution of silver iodide (in acetone) into a propane flame at a rate of 6 grams per hour to produce 10^{12} to 10^{13} nuclei a second. The District moved generators from previous sites 6, 7, and 8 to present sites 10, 18, and 19 so as to avoid seeding the Pine Mountain burn area.

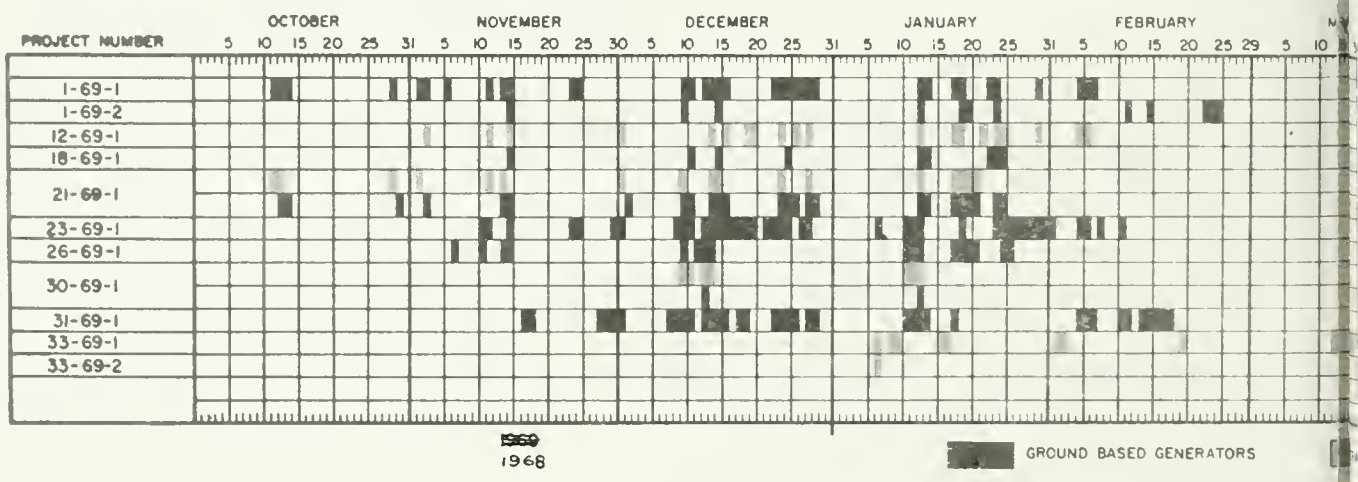
Summary	Month			Total
	Nov.	Dec.	Jan.	
Hours of Operation				
Generator No. / Location				
1 Pacoima-Spreading Grounds	6.50	0	0	6.50
2 LaTuna Debris Basin	0	0	16.75	16.75
3 Pickens Patrol Station	7.50	0	29.50	37.00
4 Devils Gate Dam	0	0	46.00	46.00
5 Eaton Spreading Basin	0	0.75	14.25	15.00
11 Mount Baldy Guard Station	2.00	0	12.25	14.25
12 Tanbark Flat	6.00	6.50	38.75	51.25
13 Pine Mountain	0	7.50	34.50	42.00
14 Spring Camp	0	8.25	44.00	52.25
15 Mount Wilson	8.00	3.75	16.25	28.00
16 Red Box Ranger Station	7.25	4.00	34.25	45.50
17 Big Tujunga Dam	7.25	11.00	37.00	55.25
18 Cogswell Dam	6.75	11.25	46.75	64.75
19 East Fork Ranger Station	8.50	3.00	50.50	62.00
Total	59.75	56.00	420.75	536.50
Storms	1	3	2	6
Days of Seeding	1	3	5	9
AgI Used (grams)	358	336	2,525	3,219



PROJECT Nº 18-69-I: SAN GABRIEL MOUNTAINS

PLATE

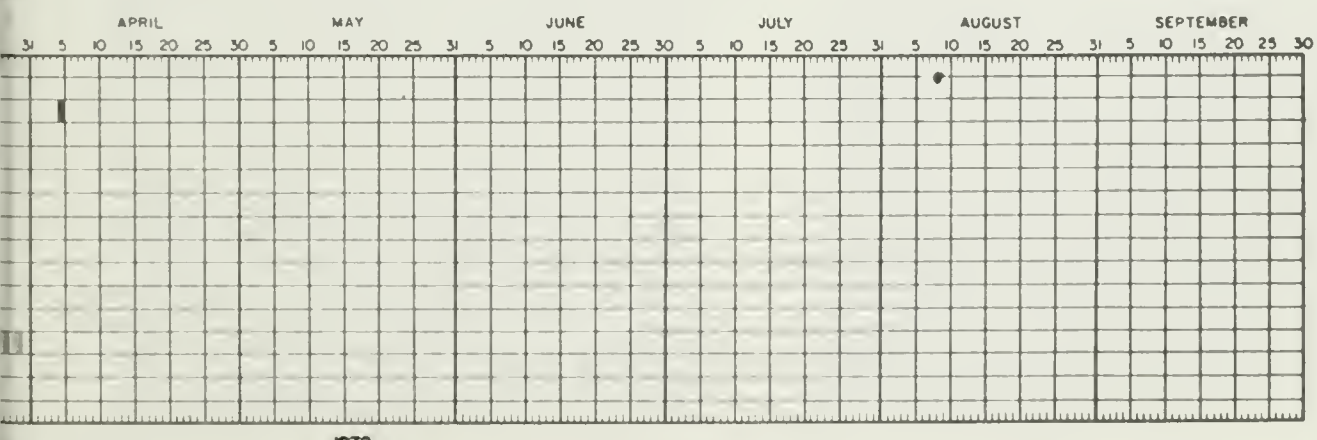
PROJECT No.	LICENSE No.	YEAR 1968	YEAR 1969	LIC
1-69-1	1	X	X	North American Weather Consultants Santa Barbara Municipal Airport Goleta, California 93017
1-69-2	1	X	X	North American Weather Consultants
	[illegible]	X	X	Water Resources Development C Weather Modification Projects 611 South Palm Canyon Drive, S Palm Springs, California 92262
12-69-1	12	X	X	Precipitation Control Company 105 Pierce Street Taft, California 93268
18-69-1	18	X	X	Los Angeles County Flood Co P. O. Box 2418 [illegible] Annex Los Angeles, California 90054
21-69-1	21	X	X	Atmospherics Incorporated 4981 East Dakota Avenue Fresno, California 93727
	22	X	X	San Bernardino Valley Municipal 1350 South E Street P. O. Box 5906 San Bernardino, California 9240
23-69-1	23	X	X	Pacific Gas and Electric Compa 245 Market Street San Francisco, California 94106
	24	X	X	International Weather Control, In 40 West First Street, Suite 104 Reno, Nevada 89501
	25	X	X	K.R.C. Service Corporation 2956 C Street San Diego, California 92102



E.THER MODIFICATION PROJECTS IN CALIFORNIA: 1969 WATER YEAR

	CLIENT	PROJECT No	LICENSE No.	YEAR 1968	YEAR 1969	LICENSEE	CLIENT
		[illegible]	[illegible]	X	X	[illegible]	[illegible]
			[illegible]	X	X	[illegible]	
			28	X	X	[illegible]	
			29	X	X	World Weather, Incorporated 625 Commercial Bank Tower Midland, Texas 79701	
		31-69-1	30	X	X	Fresno State College Foundation Atmospheric Water Resources Research 4831 East Shields Avenue Fresno, California 93726	
		31-69-1	31	X	X	Weather Measure Corporation P. O. Box 41257 Sacramento, California 95841	
			32	X	X	Desert Research Institute University of Nevada System Reno, Nevada 89507	
		33-69-1	33	X	X	EG&G, Incorporated Environmental Services Operation P. O. Box 1025 Boulder, Colorado 80302	
		33-69-2	33	X	X	EG&G, Incorporated	

CLOUD SEEDING



CRAFT

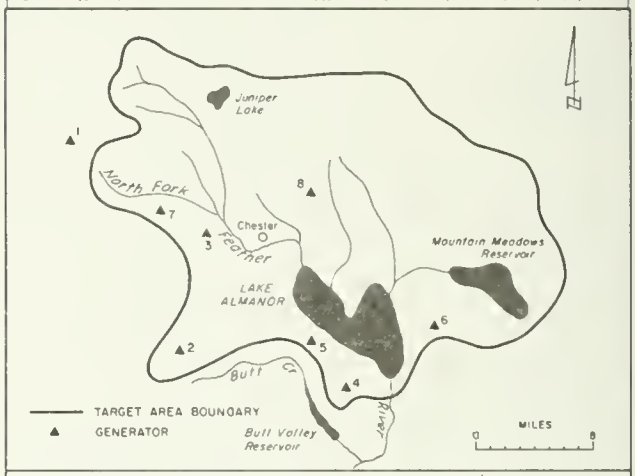
1969

Summary	Month				Total
	Oct.	Nov.	Dec.	Jan.	
Hours of Operation					
Generator					
No. 1	0	17.2	75.4	57.1	149.7
No. 2	0	16.4	50.4	81.3	148.1
No. 3	0	16.0	47.6	75.6	139.2
No. 4	6.2	25.2	37.5	101.8	170.7
No. 5	0	20.9	36.0	0	56.9
No. 6	0	7.7	0	25.7	33.4
No. 7	0	0	26.5	31.5	58.0
No. 8	0	0	37.8	24.0	61.8
No. 9	0	0	24.0	0	24.0
No. 10	0	0	47.7	10.0	57.7
No. 11	. . . . . Not Operated				
No. 12	. . . . . Not Operated				
No. 13	13.7	0	53.5	0	67.2
No. 14	13.7	0	23.5	0	37.2
No. 15	0	0	0	8.5	8.5
No. 16	. . . . . Not Operated				
Sub Total	33.6	103.4	459.9	415.5	1,012.4
Aircraft	7.6	5.1	12.6	15.2	40.5
Mobile Unit	3.8	3.3	0	0	7.1
Total	45	111.8	472.5	430.7	1,060
Storms	2	3	7	4	16
Days of Seeding	5	5	12	8	30
Flights	4	3	7	7	21
AgI Used (grams)					
Generator	504	1,551	6,898.5	6,232.5	15,186
Aircraft	570	381	945	1,260	3,156
Mobile Unit	330	120	0	0	450
Total	1,404	2,052	7,843.5	7,492.5	18,792

PROJECT Nº 21-69-1. UPPER KINGS RIVER BASIN

Project No. 21-69-1: The Kings River Conservation District hired Atmospherics Incorporated to increase precipitation in the upper Kings River Basin above Pine Flat Dam. Thirteen ground-based generators dispersed a solution of silver iodide (in acetone) into a propane flame at a rate of 15 grams per hour. Aircraft, during 21 flights, used pyrotechnic devices to disperse silver iodide at a rate of 75 grams per hour (225 grams per hour during a 0.8 hour period in January). A mobile ground unit, traveling along Highway 180, used pyrotechnic devices to disperse silver iodide at a varying rate.

Summary			Month				Total
			Nov.	Dec.	Jan.	Feb.	
Hours of Operation							
Generator No.	Location	Burner Group: West	Burner Group: South				
1	Christie Mill	X		28.6	146.9	99.1	47.6	322.2
2	Butt Mountain	X	X	44.3	133.1	126.2	62.8	366.4
3	Stover Mountain	X	X	0	178.1	5.5	0	183.6
4	Ohio Ridge		X	15.7	53.9	43.2	15.	128.1
5	Keefer Ridge	X	X	44.3	200.8	114.3	0	359.4
6	Dyer Mountain		X	0	49.8	43.1	15.2	108.1
7	Feather River Meadows	X	X	0	200.8	139.2	0	340.0
8	Mud Creek Butte	X		0	107.9	99.0	47.6	254.5
		Total		132.9	1,071.3	669.6	188.5	2,062.3
Storms				7	6	6	9	28
Days of Seeding				6	18	13	5	42
AgI Used (grams)				3,375.66	27,211.02	17,007.84	4,787.90	52,382.42



PROJECT Nº 23-69-1. LAKE ALMANOR

Project No. 23-69-1: The Pacific Gas and Electric Company sought both to increase high-level snowpack and subsequent dry season runoff and to study the effectiveness of cloud seeding in the North Fork Feather River drainage basin near Lake Almanor and Butt Valley and Mountain Meadows reservoirs. Eight high-elevation, radio-controlled generators burned a solution of silver and sodium iodide (in acetone) at the rate of 25.4 grams of silver iodide per hour. The generators operated as a group in each of two groups, West Burner and South Burner. Within each group, total hours of operation varied between generators because certain of them not always were operable.

Summary	Month					Total
	Nov.	Dec.	Jan.	Feb.	Mar.	
Hours of Operation						
Generator No. / Location						
1 Los Gatos (Skyline Boulevard)	6.6	10.7	42.3			59.6
2 Los Gatos (Skyline Boulevard)	13.7	16.0	82.3			112.0
4 Los Gatos (Skyline Boulevard)	18.8	21.7	84.9			125.4
4 Almaden Air Force Base	18.8	16.0	20.4			55.2
5 Los Gatos (Highland Way)	10.2	15.2	36.2			61.6
6 Watsonville (Riverside Road)	17.0	10.9	58.3			86.2
7 Watsonville (Bella Vista Lane)	16.7	23.9	81.0			121.6
8 Santa Cruz (Morten Avenue)	12.0	20.8	38.2			71.0
9 Santa Cruz (Old Soquel Road)	12.0	15.5	33.4			60.9
10 Corralitos (Corralitos Road)	12.2	15.5	32.8			60.5
11 San Juan Bautista	17.3	10.2	91.3			118.8
12 Salinas	10.6	5.6	0.0			16.2
13 Salinas	9.9	2.1	0.0			12.0
14 Salinas	10.6	2.2	0.0			12.8
15 Watsonville (Freedom Road)	0.0	0.0	0.0			0.0
16 Hollister	10.2	7.4	5.5			23.1
17 Gilroy	11.9	20.2	70.0			102.1
18 Morgan Hill	9.4	20.4	46.4			76.2
19 San Juan Bautista	16.5	2.4	61.3			80.2
20 Hollister	10.2	4.6	21.3			36.1
21 Watsonville (Eureka Canyon Road)	5.2	22.0	42.7			69.9
22 Radar Trailer County Communication	0.0	0.0	0.0			0.0
Totals	249.8	263.3	848.3			1,361.4
Storms	3	3	4	6	4	20
Days of Seeding	4	4	9	0	0	17
AgI Used (grams)	6,244	6,583	21,208	0	0	34,035

PROJECT Nº 26-69-1: SANTA CLARA COUNTY

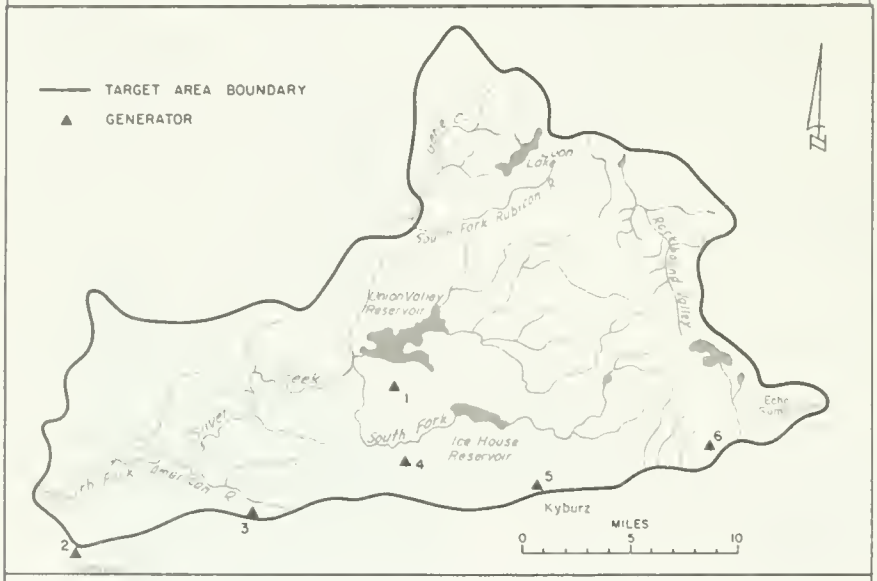
Summary	Month		
	Dec.	Jan.	Total
Hours of Operation			
Aircraft	5.75	8.75	14.50
Mobile Unit	.50	1.00	1.50
Total	6.25	9.75	16.00
Storms	3	1	5
Days of Seeding	5	3	8
Flights	6	5	11
AgI Used (grams)			
Aircraft	26,733	23,541	50,274
Mobile Unit	200	372	572
Total	26,933	23,913	50,846

PROJECT Nº30-69-1 CENTRAL SIERRA RESEARCH

Project No. 26-69-1: Santa Clara County Flood Control and Water District sought to increase rainfall and subsequent water supply within Santa Clara County. Modified starfire ground generators dispersed silver iodide at the rate of 25 grams per hour.

Project No. 30-69-1: Fresno State College Foundation, Atmospheric Water Resources Research, experimented with weather modification in the watersheds of the Stanislaus and Mokelumne Rivers above an elevation of 6,000 feet. This Central Sierra Research (CENSARE) Project, a cooperative program, received research assistance from both Meterology Research, Inc., and the Desert Research Institute of the University of Nevada. It received both services and equipment from the Pacific Gas and Electric Company, the East Bay Municipal Utility District, and the Earth and Planetary Sciences Division of the Naval Weapons Center in China Lake. It received financial support from the United States Bureau of Reclamation, with whom it had a contract. During 11 flights, pyrotechnics (fusees), wing-mounted on aircraft, each burned 399 grams of silver iodide in 150 seconds to produce 2.5 x 10^{15} nuclei (measured at -12°C). Fixed and mobile ground flares each burned 28.6 grams of silver iodide in 45 seconds to produce 2.0 x 10^{15} nuclei (measured at -12°C).

Summary	Month				Total
	Nov.	Dec.	Jan.	Feb.	
Hours of Operation					
Generator No. / Location					
1 Big Hill	0	0	0	0	0
2 Camino	11.0	198.5	77.5	114.0	401.0
3 Fresh Pond	49.0	120.0	0	0	169.0
4 Log Deck (Peavine)	41.5	206.0	75.5	146.0	469.0
5 Kyburz	15.5	210.5	75.5	41.0	342.5
6 Strawberry	15.5	211.0	75.5	41.0	343.0
Total	132.5	946.0	304.0	342.0	1,724.5
Storms	3	6	10	5	24
Days of Seeding	5	17	5	10	37
AgI Used (grams)	3,312.5	23,650.0	7,600.0	8,550.0	43,112.5



PROJECT Nº 31-69-1: UPPER AMERICAN RIVER

Project No. 31-69-1: The Sacramento Municipal Utility District hired the Weather Measure Corporation to increase snowpack in the Upper American River Basin. Six ground-based generators dispersed 43,112 grams of silver iodide at the rate of 25 grams per hour in an area north of U. S. Highway 50 between Camino and Echo Summit.

Project No. 33-69-1: The Sacramento County Department of Airports hired the Environmental Services Operation of Edgerton, Germeshausen and Grier, Inc., to disperse fog on the runway and approach to Sacramento Metropolitan Airport. Aircraft dispersed milled sodium chloride mixed with Cab-O-Sil (a commercial fused silica) to prevent its agglomeration in the hopper (capacity, 1,000 pounds). The pilot regulated flow by means of controls in the cockpit. The rate of flow he permitted depended upon the density of the fog, and varied from 40 to 150 pounds per minute.

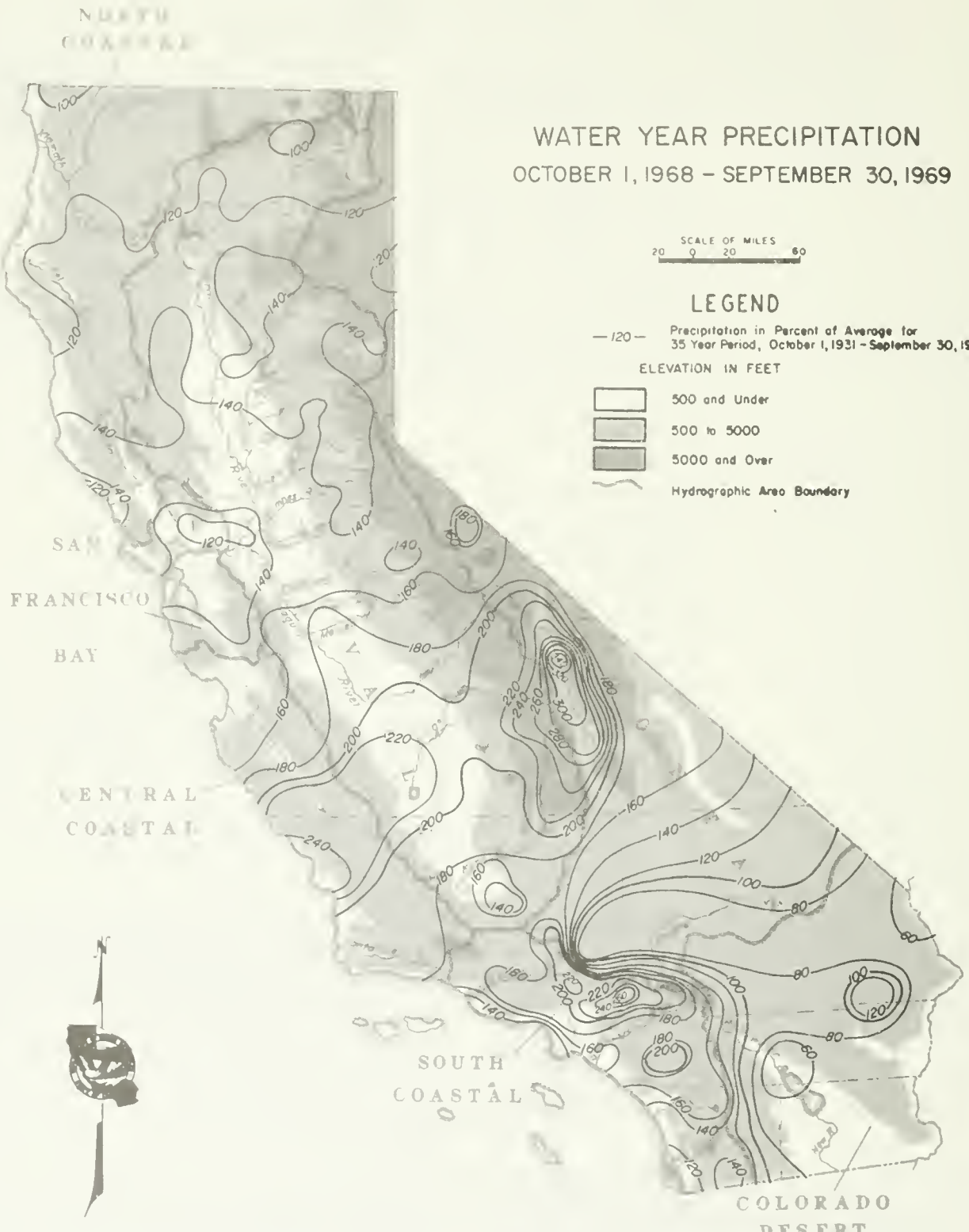
Project 33-69-2: The Los Angeles Board of Airport Commissioners hired the same firm to disperse fog on the runway and approach to Los Angeles International Airport. The materials dispersed and the method of dispersal were the same as for Sacramento Metropolitan Airport.

NOTE: RVR Runway Visual Range = the maximum distance from the cockpit of an aircraft at the end of the runway during the [illegible] period

Project No.	Date		Seeding					Runs	Weather Conditions				Evaluation**		
			Time		Materials				Fog Depth (Feet)	°F		Wind Speed (Knots)	Successful		None Made
	Month	Day	From	To	NaCl Grade*	NaCl Pounds	CaB-O-Sil Pounds			Temperature	Dew Point		Yes	No	
33-69-1	January	7	0625	0635	Fine	600	10	2		43	31				X
	"	"	0630	0650	Fine	750	10	5	1700	43	31	0-5			X
			Drizzle over runway. During flights, RVR varied from 2,400 to 10,500 feet												
	"	9	0630	0710	Fine	100	10	4	500	34	32	0-3	X		
	"	"	0805	0858	Fine	700	10	8		34	32	3-5	X		
	"	"	1200	1219	Fine	1000	20	3		39	38	4	X		
			Between the start of the first and the end of the second flight, RVR increased from 1,200 to 2,600 feet. It increased further during Flight Three.												
	"	10	0731	0756	Fine	1000	20	5		35	34	3-5		X	
			Hopper would not close. RVR unimproved.												
	"	16-17	2327	0125	200/Fine	200/200	20	17	175	38	38	4-6		X	
	"	17	0614	0711	200	1000	30	8	205	36	36	3-6		X	
	"	"	1005	1029	Fine	900	70	8		41	40	4		X	
	"	"	2211	2234	200/Fine	700/200	20	5	600	44	43	5-7		X	
			Although RVR increased slightly during the first and rapidly during the third flight, winds carried more fog into the area.												
	February	2	1005	1040	200	1000	10	10		44	44	10-12			X
			RVR varied from 3,960 to 5,280 feet as flight began. The fog, which formed after sunrise, already was lifting.												
	"	3	0610	0710	200	1000	10	12		36	36	6-8	X		
	"	"	0740	0815	200	1000	10	10		36	36	6-8	X		
	"	"	0840	0920	200	1000	10			39	39	6	X		
			RVR, which varied from 1000 to 1600 feet during flights One and Two, exceeded 2,400 feet with Flight Three.												
	"	20	0724	0755	200/Fine	500/500	10	8	1100	46	45	3-5	X		
	"	"	0835	0915	Fine	400	50	8	600	47	44	8	X		
	"	"	0952	1012	200/Fine	450/450	50	5		48	47	8	X		
			Flight One, reversing a downtrend in RVR, attained an RVR of 3,000 feet by 7:47 a.m. Flights Two and Three sustained visibility.												
	March	13	0645	0720	200/Fine	350/350		5		35	35	5	X		
	"	"	0725	0754	200/Fine	350/350		8		36	35	5	X		
	"	"	0842	0919	200	650	50	4		41	39	6	X		
			Flight One increased RVR to 1,400 feet; Flight Two, to 2,000 feet (enabling five aircraft landings). Flight Three sustained that RVR.												
33-69-2	January	7	0602	0652	200	1300	50	8		52	50	2-3	X		
			Two planes, by 6:40 a.m., attained an RVM varying from 1,800 to 3,000 feet.												
	March	28	0503	0648	200	2400	40	23	600	54	53	2-6	X		
			Three planes, reversing a downtrend in RVR, attained an RVR of 1,000 feet by 5:40 a.m., and one of 6,000 feet by 6:20 a.m. Offset seeding resolved problems of fog drift.												
	"	30	0509	0700	200	3200	40	21	800	54	53	5-8	X		
			Three planes attained a heavy drizzle by 6:05 a.m. and an RVR of 3,000 feet by 6:30 a.m. Offset seeding resolved problems of fog drift.												

*Grade 200: particle diameters range from 2 to 60 microns, with 80% of diameters between 8 and 24 microns.
Grade Fine: Particle diameters range from 2 to 100 microns, with 65% of diameters between 10 and 25 microns.

**Successful Evaluation: RVR improved at least 1,600 feet (takeoff minimum).
Unsuccessful Evaluation: RVR remains below 1,600 feet.
No Evaluation: RVR already exceeds 2,400 feet, although seeding flight made through fog.



NOTE: Bulletin No. 120-69, "Water Conditions in California Fall Report", Dated October 1969, Provides Detailed Precipitation Data For The Water Year

Copies of this bulletin at $1.00 each may be ordered from:
Office of Procurement
DOCUMENTS SECTION
P.O. Box 20191
Sacramento, California 95820
Make checks payable to STATE OF CALIFORNIA.
California residents add 5 percent sales tax.

THIS BOOK IS DUE ON THE LAST DATE
STAMPED BELOW

BOOKS REQUESTED BY ANOTHER BORROWER
ARE SUBJECT TO RECALL AFTER ONE WEEK.
RENEWED BOOKS ARE SUBJECT TO
IMMEDIATE RECALL

RECEIVED PSI
MAR 2 0 1992

LIBRARY, UNIVERSITY OF CALIFORNIA, DAVIS
D4613 (12/76)

UNIVERSITY OF CALIFORNIA DAVIS
3 1175 02037 6706

TC
824
C2
A2
no.16:62-72

PHYSICAL
SCIENCES
LIBRARY

California. Dept. of Water Resources.
Bulletin.